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HEAT AS AN INSECTICIDE IN THE HERBARIUM

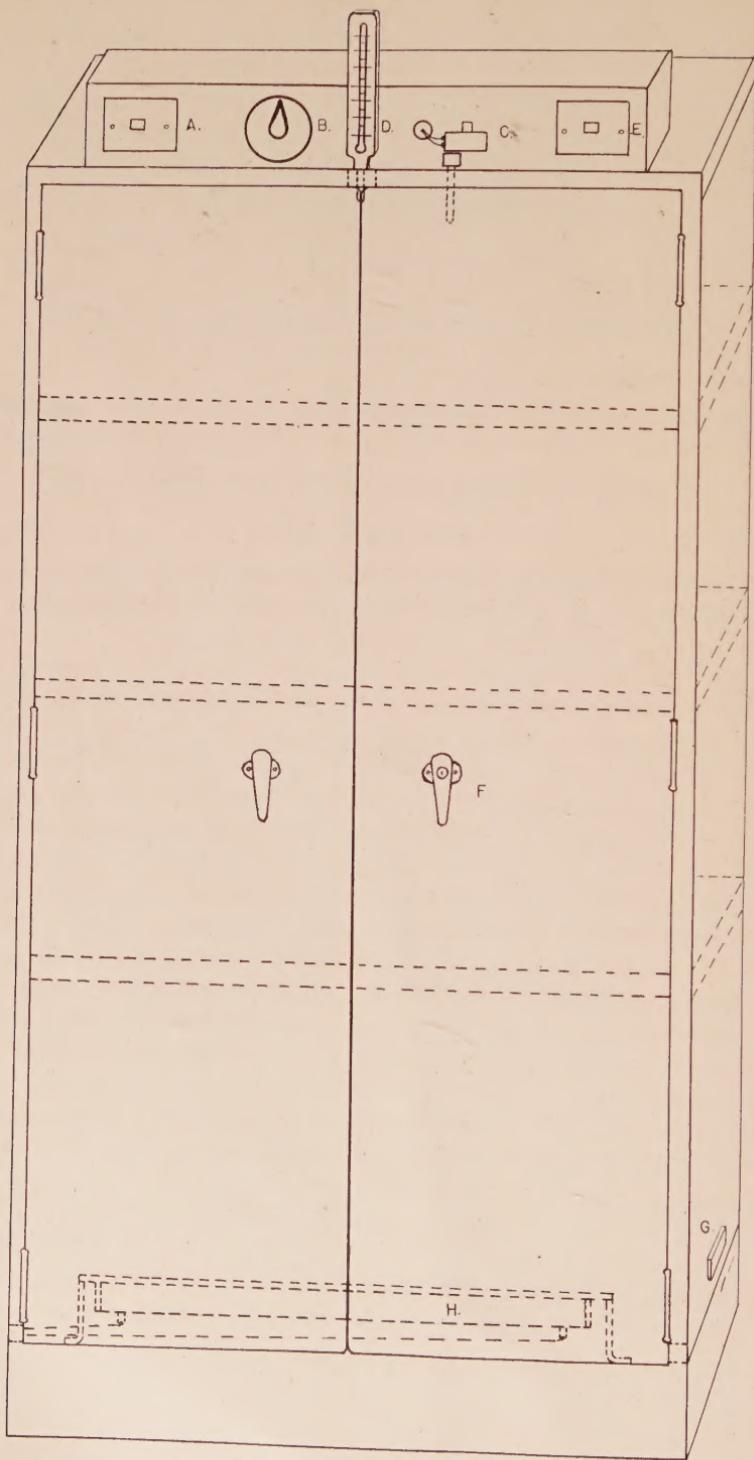
HUGH O'NEILL

INSECT pests in plant collections are controlled (a) by poisoning the specimens; (b) by periodical fumigation; (c) by the use of repellants; (d) by some combination of these three methods.

In "La Conservazione degli Erbari e l'efficacia del Sublimato (Hg Cl₂) nell' avvelamento delle piante," Passerini and Pampini¹ discuss the relative efficiency of various poisons and fumigants. All poisons are objectionable in that they are poisonous to the botanist as well as to the insect. Fumigants are objectionable because they are either poisonous to man, or explosive or have disagreeable odors. Repellants are efficient only when used in conjunction with some insecticide. All of these methods kill the eggs of insects only after relatively long periods of time. If the eggs are in fruits, such as acorns or haws, they are usually not killed by any of these methods.

Insects are killed by heat at comparatively low temperatures, e. g. the Mediterranean Fruit Fly (*Ceratitis capitata*) is killed in ten hours in any stage (egg as well as larva or pupa) by a temperature of 110° F or 43° C. Museum beetles (*Dermestes*), weevils, roaches, tripetids in acorns, gall-worms in stems were found by the author to succumb as easily to mild temperatures. These tests were made in a steel case designed by the writer and figured herewith. The case is of the same style, finish and construction as the steel cabinets in this herbarium (i. e. substantially the same as those in use in the Gray Herbarium) except that the walls and the doors are of double layers of sheet steel with asbestos filling between the layers. The insulation greatly re-

¹ Soc. Bot. Ital. (Firenze) Nuova Serie Vol. 34. (1927).



duces loss of heat by radiation through the walls and doors and also makes the apparatus fireproof according to the Underwriters' inspection.

In order to preclude the remotest possible chance of plants taking fire, specimens are never placed on the lowest shelf. On this lowest shelf may be placed a pan of water to prevent excessive drying of specimens.

On account of the low conductivity of the sheets of paper and of the plants themselves, the transfer of heat from the outside of a bundle of plants to the inside takes place very slowly. In practice this may be overcome safely by using a temperature of about 170° F or 77° C. In about 4 to 6 hours this will raise the temperature in the inside of a bundle of plants to about 140° F (60° C), a temperature sufficient to kill insects in any stage in a few minutes without damaging the plant specimens in any way. In fact, in drying plants between corrugated cardboard and blotters, as ordinarily practiced in the tropics, the plants are often subjected to considerably higher temperatures. It is believed that this method of killing insects is more thorough and more rapid and less expensive than any known method. In contrast to the commonly used insecticides it is: (a) Not poisonous (as are hydrogen cyanide, mercury bichloride, sodium arsenite, carbon bisulfide, sulphur dioxide); (b) Not explosive (as are hydrogen cyanide, carbon bisulfide); (c) It really kills all eggs of insects in large fruits in a few hours.

A vent in the roof of the cabinet and a vent in either wall (G) near the floor converts the heat-treater into an efficient apparatus for drying plants in presses made of corrugated cardboard and blotters.

The apparatus figured here, has been used since June 1933 to treat nearly 200,000 sheets of plants as well as a collection of fungi. No insect pests have been discovered in the plants in this herbarium since that date.

The specifications of this heat-treating cabinet are as follows: Height 70 inches; Width 37 inches; Depth 24 inches. Capacity 3000 to 6000 mounted or unmounted herbarium specimens.

EXPLANATION OF FIGURE

(H) Two 500-watt 110-volt space heaters connected in series paralleled with (B) a three-heat indicating switch located at top of cabinet. Each of these heaters is bolted to a 4" x 30" x 1/8" plate with $\frac{1}{4}$ " asbestos board between plate and heater. Plate is supported 2" above bottom of cabinet and placed 7" and 15" inside and parallel to front surfaces.

(C) Immersion type mercoil thermal cutout having a range of approximately 120-200° F. This regulator is wired in series with the supply line.

(A and E) Two candelabra base pilot receptacles containing Neon lamps behind a suitable bull's-eye, one pilot across heater elements and one across line ahead of thermal cutout and switch. This to enable operator to tell when (A) cabinet is connected to line when (E) heater is operating. Not shown on diagram is a receptacle at (I) left side of cabinet 8" from floor to allow connection by means of a two conductor no. 14 asbestos heater cord.

Four shelves made of no. 10 wire woven in a one-inch diamond mesh and welded to a suitable frame are shown by double horizontal dotted lines.

(G) Three ventilation holes cut through cabinet one at each side near bottom and one in the top, each hole approximately 3" x 6" and fitted with reasonably tight covers.

(D) Thermometer indicating air temperature inside cabinet.

(F) Handles to doors.

Specifications for the electrical equipment were drawn by Mr. Robert E. Robson.

LANGLOIS HERBARIUM,
CATHOLIC UNIVERSITY OF AMERICA,
WASHINGTON, D. C.

NOTES ON THE CLADONIAE OF CONNECTICUT—III¹

ALEXANDER W. EVANS

THE present series of notes represents the third supplement to the writer's report on the Cladoniae of Connecticut,² published in 1930. This report was based on collections made down to the close of 1928. The first supplement³ brought the record down to 1931, and the second⁴ to 1933. In this third supplement the record is brought down to the close of 1936. The writer has again enjoyed the kind cooperation of Dr. Heinrich Sandstede of Bad Zwischenahn, Oldenburg, in the preparation of this paper and would again extend to him his grateful thanks. Dr. Sandstede has examined the majority of the specimens listed and has commented on some of the more critical species, varieties, and forms.

The names of most of the collectors mentioned on the following pages have already appeared in the writer's earlier papers on Cladoniae. During the past three years a number of additional botanists have sent in material for study, and a few specimens of earlier date have come to light. The new names, which will be cited in connection with individual specimens, are as follows: Miss Dorothy Arnold, B. Livings-

¹ Contribution from the Osborn Botanical Laboratory.

² Trans. Connecticut Acad. 30: 357-510. 1930.

³ RHODORA 34: 121-142, 153-164. 1932.

⁴ Ibid. 37: 33-57. 1935.

ton, R. Darrow, G. R. Kleeberger, H. R. Muegel, C. E. Olmsted, W. A. Setchell, and A. G. Snow. The specimens collected by Livingston, Kleeberger, and Setchell are fifty years old or more, but most of the other specimens listed are of recent date. The collections made by Mr. H. R. Muegel of the University of Cincinnati have been of especial interest and have added appreciably to our knowledge of the local distribution of the Cladoniae in Connecticut. Records cited with dates only are based on collections made by the writer, and all records, unless especially noted, are represented by specimens in the Yale Herbarium.

The long-awaited Lichen Flora¹ by Professor Bruce Fink, completed for publication by Joyce Hedrick, appeared in 1935. The treatment of the genus *Cladonia* in this important work is somewhat at variance with the treatment in the writer's publications. This is largely due to the broader definition of certain species and to the almost complete disregard of chemical distinctions. As an example of broad definition *C. fimbriata* may be considered. In the Fink Flora this species includes seven varieties, whereas five of these varieties are regarded as distinct species in the writer's report and notes. As examples of the disregard of chemical distinctions the inclusion of *C. clarulifera* under *C. subcariosa* and of *C. mitis* under *C. sylvatica* may be selected. The Fink treatment of the genus is, on the whole, in accordance with the views of Tuckerman; the writer's treatment on the contrary is more in accordance with the views of Vainio and Sandstede.

The study of chemical distinctions in the Cladoniae has been greatly advanced by Asahina's recommendation of paraphenylenediamine² for the detection of fumarprotocetraric acid. Students of the Cladoniae had heretofore attempted to demonstrate the presence of this wide-spread acid by means of its bitter taste, but this method is far from satisfactory because to many persons the bitter taste is either elusive or wholly imperceptible. Paraphenylenediamine, however, if fumarprotocetraric acid is present, gives a definite color reaction, a yellow quickly deepening to orange-red or brick-red. To obtain this reaction the reagent should be applied to dry material in the form of a freshly prepared alcoholic solution.³ Although most of the specimens which had been pronounced bitter by Sandstede and by

¹ The Lichen Flora of the United States i-x, 1-426, f. 1-4, pl. 1-47. Ann Arbor 1935.

² Ueber die Reaktion von Flechten-Thallus. Acta Phytochimica 8: 47-64. 1934.

³ For further details see Torrey, Paraphenylenediamine, a new color test for lichens. Torreya 35: 110-112. 1935.

Robbins react positively with the new reagent, whereas those which had been pronounced mild react negatively, a few exceptions have been met with. These were particularly evident in plants which had been referred to *C. chlorophphaea* or *C. Grayi* on the basis of differences in taste. For this reason the lists of stations under these two species are completely revised in the present paper, according to the results obtained with paraphenylenediamine.

Although the new reagent gives an orange-red or brick-red color with fumarprotocetraric acid, these colors are not absolutely diagnostic for this particular acid. Similar colors are obtained, for example, with *C. macilenta*, *C. digitata*, and *C. delicata*, in spite of the fact that fumarprotocetraric acid has not been demonstrated in any of these species by chemical analysis. The reaction in these cases is obviously due to the presence of thamnolic acid, to which Asahina assigns a yellow color, deepening to orange- or brick-red when treated with paraphenylenediamine. It will be remembered that thamnolic acid gives a deep yellow color when acted upon by potassium hydroxide. In certain *Cladoniae* paraphenylenediamine gives a yellow color which does not deepen to orange or reddish. This is the case, for example, with *C. squamosa* f. *levicorticata*, although other forms of this polymorphic species, such as f. *denticollis*, are definitely negative. Apparently various substances might be responsible for this persistent yellow color. In the following list the reactions of the various species with paraphenylenediamine are indicated by means of the symbols P+ and P-. P+ signifies a positive reaction, in which a definite reddish color is obtained; P- a negative reaction or one in which the color is not reddish.

Fifty-three species of *Cladonia* were known from Connecticut at the close of 1933, and two additional species have been detected since that date. Unfortunately *C. impexa*, one of the species included in the writer's original report (p. 386), can no longer be considered a member of the Connecticut flora. This species is negative with paraphenylenediamine, but all the specimens upon which the Connecticut records were based are positive and must therefore be transferred to *C. sylvatica* or *C. tenuis*. The total number of species for the State, therefore, is fifty-four. It is hoped that the true *C. impexa* may yet be discovered within our limits. According to our present knowledge it is more northern than our other species of *Cladina*, although found in eastern Massachusetts.

The sequence of species in the present series of notes is the same as in the writer's earlier papers on *Cladonia* and all page-references, unless otherwise noted, relate to the original report of 1930. The first series of notes is indicated by "Notes" and the second series by "Notes II." Species or forms reported for the first time from Connecticut are distinguished by asterisks.

Subgenus CLADINA

CLADONIA RANGIFERINA (L.) Web. (p. 375). P+. Canaan (1936), Kent (*Muegel*, 1936), Middletown (*Muegel*, 1935), Pomfret (*Mrs. Paine*, 1934), Somers (1934), Warren (1934), and Woodbridge (1935).

**CLADONIA RANGIFERINA* f. *INCRASSATA* Schaer. Lich. Helv. Spic. 38. 1823 (*as C. rangiferina incrassata*). On earth in a field, Goshen (1934, det. Sandstede).

The podetia in this form are more robust than in the usual forms of the species, and the surface in the older parts is wrinkled and verruculose.

CLADONIA RANGIFERINA f. *TENUIOR* (Del.) Mass. (Notes, p. 122). Farmington (1934).

**CLADONIA RANGIFERINA* f. *LEUCITICA* Flot. in Sandstede, Abhandl. Naturw. Ver. Bremen 25: 94. 1922. On earth in a field, Simsbury (1936, det. Sandst.).

According to Sandstede f. *leucitica* is a shade plant and is distinguished by its sparse branching and pale color, with only the extreme tips of the ultimate branchlets showing a brownish pigmentation.

CLADONIA RANGIFERINA f. *UMBELLATA* Anders (Notes II, p. 35). Canaan (1936) and Goshen (1934, det. Sandstede).

CLADONIA RANGIFERINA f. *PROLIFERA* Flot. (p. 377). Goshen (1934).

CLADONIA SYLVATICA (L.) Hoffm. (p. 378). P+. Barkhamsted (*McDonnell*, 1933; *Evans*, 1934), Durham (1932), Farmington (1934), Goshen (1934, 1935, det. Sandstede), Kent (*Muegel & Evans*, 1936), Madison (*Muegel*, 1935, the earlier record for this town was based on specimens of *C. mitis*), Milford (1932), New Haven (*Livingston*, 1873, not earliest record for town), Torrington (1934, det. Sandstede) and Warren (1934). The specimens dated 1932 or 1933 have been incorrectly listed as *C. mitis* (see Notes II, p. 36).

CLADONIA SYLVATICA f. *SPHAGNOIDES* (Floerke) Oliv. (p. 380). New Haven (*Hall*, 1874, Hall Herbarium, listed on p. 387 as *C. impexa* f. *laxiuscula*).

CLADONIA SYLVATICA f. *PYGMAEA* Sandst. (p. 381). Branford (1936), Middletown (1935), Warren (1934, det. Sandstede), and Woodbridge (1935).

**CLADONIA SYLVATICA* f. *SETIGERA* Oxner ex Sandstede in Raben-

horst, Kryptogamen-Flora 9, Abt. 4²: 46. 1931. On earth in fields. Branford (1928), Torrington (1934, det. Sandstede) and Union (1927). The specimens from Branford and Union have been incorrectly listed as *C. mitis* (see Report, p. 381).

The minute hair-like or needle-like appendages which characterize *f. setigera* are originally pale in color but may become darkened with age. They are rather sparingly produced in most cases and occur along the sides of the podetia as well as at the tips of the ultimate branchlets. The form is analogous to *C. tenuis* *f. setigera*.

CLADONIA MITIS Sandst. (p. 381). P-. Canterbury (1933, not new to town), Colchester (1935), Eastford (1934), Griswold (1933, not new to town), Hartland (1934), Killingworth (Hall, 1874, antedating record in Notes II, p. 36; Evans, 1932), Ledyard (*L. Sudbury*, 1927, not previously reported), Lyme 1930, not new to town), Madison (1927, not new to town), Mansfield (1934), North Haven (*Britton*, 1901, antedating records in Report, p. 381), Oxford (1936), Shelton (1928, not new to town), Somers (1934), and Voluntown (1933). The specimens upon which these records are based are all negative with paraphenylenediamine. Those dated 1933 or earlier have been incorrectly listed as *C. sylvatica* (see Report, p. 378; Notes, p. 123; and Notes II, p. 36).

CLADONIA MITIS *f. PROLIFERA* Sandst. (p. 383). Bethany (*Muegel*, 1935), North Branford (*Musch & Evans*, 1927), Shelton (1928, not new to town), Somers (1934), and Wilton (1931). These specimens (with the exception of the third) have been incorrectly listed as *C. sylvatica* *f. prolifera* (see Report, p. 381, and Notes, p. 123); they are all negative, however, with paraphenylenediamine. The true *C. sylvatica* *f. prolifera* has not yet been found in Connecticut.

CLADONIA TENUIS (Floerke) Harm. (p. 384). P+. Barkhamsted (1928, incorrectly listed in Report, p. 386, as *C. impexa*; not new to town), Bloomfield (1936), Canaan (1936), Colchester (1934), Coventry (1934), Farmington (1934), Glastonbury (1934), Groton (1936), Mansfield (1934), New London (1936), Oxford (1936), Pomfret (*Mrs. Paine*, 1934), Sharon (1936), Somers (1934) Torrington (1934), Warren (1904), Windsor (*Britton*, 1900, *Britton Herbarium*, antedating record in Report, p. 384), and Woodbury (1936).

CLADONIA TENUIS *f. FLAVICANS* (Floerke) Harm. (p. 385). Killingworth (*Hall*, 1874, det. Sandstede, earliest record for Connecticut). This specimen has been incorrectly listed as *C. impexa* (see Report, p. 386).

CLADONIA TENUIS *f. SETIGERA* Sandst. (Notes, p. 123). Chester (*Musch & Evans*, 1928), Clinton (1935), Colchester (1934), Coventry (1934), East Haddam (1934), Enfield (1934), Hartland (1934), Ledyard (*Musch & Nichols*, 1925), Mansfield (1934), North Canaan (1928), Old Saybrook (1928), Pomfret (*Mrs. Paine*, 1934), Salem

(1935), Southbury (1926), Southington (1935), Warren (1934), Washington (1922), Westbrook (1935), and Woodbury (1936). The specimens dated 1928 or earlier have all been incorrectly listed as *C. impexa* (see Report, p. 386) or as *C. impexa* f. *laxiuscula* (see Report, p. 387). These specimens, although showing more or less superficial disintegration, give a positive reaction with paraphenylenediamine and must therefore be excluded from *C. impexa*, which is definitely negative.

Subgenus PYCNOTHELIA

CLADONIA PAPILLARIA (Ehrh.) Hoffm. f. **MOLARIFORMIS** (Hoffm.) Schaeer. (p. 390). P—. Colchester (1934), Farmington (1934), Goshen (1934), Plainville (1935). Pomfret (1934), Salem (1935), Salisbury (1935), and Southington (1935, 1936).

CLADONIA PAPILLARIA f. **PAPILLOSA** Fr. (p. 391). Colchester (1934), Goshen (1934), North Branford (*Muegel*, 1935), Pomfret (1934), Salem (1935), and Southington (1935, 1936).

CLADONIA PAPILLARIA f. **EPISTELIS** Sandst. (Notes, p. 123). Branford (1936, determination verified by Sandstede).

Subgenus CENOMYCE

Section COCCIFERAE

Subsection SUBGLAUCESCENTES

CLADONIA FLOERKEANA (Fr.) Floerke var. **INTERMEDIA** Hepp (p. 393). P—. Bethany (1935), Coventry (1934), Guilford (1936), Southington (1936), and Torrington (1934).

CLADONIA FLOERKEANA var. **CARCATA** (Ach.) Vainio (p. 394). Barkhamsted (1934), Bethany (1935), Coventry (1934), Kent (1936), Salisbury (*Darrow*, 1935), and Southington (1936).

CLADONIA FLOERKEANA var. **CARCATA** f. **SQUAMOSISSIMA** (Th. Fr.) Vainio (p. 394). Barkhamsted (1934).

CLADONIA BACILLARIS (Ach.) Nyl. (p. 395). P—. Bloomfield (1936), Bristol (1934), Colchester (1934), Farmington (1934), Glastonbury (1934), Goshen (1934), Killingly (1934), Mansfield (1934), Norwich (1935), Oxford (1936), Pomfret (*Mrs. Paine*, 1934), Salem (1935), Southington (1935), Stratford (1934), Southington (1936), Thomaston (1935), Torrington (1934), Winchester (1935), and Woodbury (1936).

CLADONIA BACILLARIS f. **CLAVATA** (Ach.) Vainio (p. 397). Beacon Falls (*Muegel*, 1936), Farmington (1934), Salem (1935), Sharon (1936), and Voluntown (1935).

CLADONIA BACILLARIS f. **PERITHETA** (Wallr.) Arn. (p. 397). Bethany (1935, det. Sandstede) and Voluntown (1935).

CLADONIA BACILLARIS f. **REAGENS** Evans (p. 397). Southington (1935).

CLADONIA BACILLARIS f. **SUBTOMENTOSULA** Sandst. (Notes II, p. 38). Bethany (1935), Branford (1936), Canaan (*Muegel*, 1936), and Goshen (1934).

CLADONIA BACILLARIS f. *PITYROPODA* Nyl. (Notes II, p. 38). Goshen (1934).

CLADONIA BACILLARIS f. *TENUISTIPITATA* Sandst. (Notes II, p. 39). Torrington (1934).

CLADONIA BACILLARIS f. *ABBREVIATA* (Vainio) Harm. (Notes, p. 124). Barkhamsted (1934), Eastford (1934), East Haddam (1934), Kent (1936), and North Canaan (1936). These specimens, with the exception of the last, were determined by Sandstede.

CLADONIA MACILENTA Hoffm. f. *STYRACELLA* (Ach.) Vainio (p. 399). P+. Colchester (1935), Goshen (1934), Killingly (1934), and Litchfield (1936).

CLADONIA MACILENTA f. *GRANULOSA* Aigret (p. 400). Goshen (1934) and Winchester (1935).

**CLADONIA DIGITATA* (L.) Hoffm. Deutschl. Fl. 2: 124. 1796. *Lichen digitatus* L. Sp. Plant. 1152. 1753. P+. On logs, tree-bases, or soil rich in humus. Canaan (*Muegel*, 1936).

Although the synonymy given above is correct, so far as the names are concerned, it is by no means certain that the plants called *Lichen digitatus* by Linnaeus and those called *Cladonia digitata* by Hoffmann are the same as those now called *C. digitata*. Vainio,¹ in fact, accredits the name simply to Schaeerer (Lich. Helv. Spic. 22, 1823), on the basis of specimens in the Schaeerer Herbarium, which agree with the modern conception of the species. According to the International Rules of Botanical Nomenclature, adopted in 1930, the citation of Schaeerer as author is incorrect, since Article 47 distinctly states: "an alteration of the diagnostic characters or of the circumscription of a group does not warrant the citation of an author other than the one who first published the name."

The distribution of *C. digitata* is circumpolar, and the species has long been known from Canada and northern New England, as well as from the Adirondacks and Appalachians. The specimens from Canaan are scanty, and the few podetia present are very irregularly developed. The plants are therefore referred simply to the species. Aside from the illustrations of *C. digitata* in European works, Torrey's excellent figures of North American specimens should be consulted.²

The primary squamules of the present species are larger than in any other member of the Cocciferae and are variously lobed or incised. The upper surface varies from grayish green to olive green and the lower from whitish to yellowish, deepening to brownish orange toward the base. In most cases fine soredia are present, especially along the

¹ Acta Soc. F. et Fl. Fennica 4: 123. 1887.

² Torreya 34: pl. 1, f. 3. 1934.

margins. The podetia, in their most characteristic development, form distinct cups, which broaden out gradually from the base, but in certain forms the cups are irregular and indistinct and may even be replaced by more or less pointed structures. The podetial cortex, which is restricted to the lower part, presents a smooth or wrinkled appearance. Above the base patches of fine soredia appear in the cortex, and the upper part of the podetia is densely covered with similar soredia, which show a whitish or pale yellowish color, occasionally tinged with greenish. The scarlet apothecia are normally borne on the margins of the cups, but many of the podetia are sterile.

One of the most striking peculiarities of *C. digitata* is its distinct reaction with KOH, which gives a vivid yellow color, owing to a relatively large content of thamnolic acid. In this respect the species resembles *C. macilenta*, but in the latter the primary squamules are much smaller and the podetia never form true cups.

CLADONIA DIDYMA (Fée) Vainio f. *SUBULATA* Sandst. (Notes, p. 127). P—. Guilford (1936).

Subsection STRAMINEO-FLAVIDAE

CLADONIA PLEUROTA (Floerke) Schaer. (p. 400). P—. Bethany (1935), Bloomfield (1936), Glastonbury (1934), Goshen (1934), Hartford (Clark, 1933, det. Sandstede, not previously reported), Lisbon (Marshall & Evans, 1935), Norwich (1935), Salem (1935), Salisbury (1935), Somers (1934), Southington (1935), Thomaston (1935), Warren (1934), Westbrook (1935), and Woodbury (1936).

CLADONIA PLEUROTA f. *DECORATA* Vainio (p. 402). Barkhamsted (1934), Guilford (1935), and Pomfret (Mrs. Paine, 1934).

CLADONIA CRISTATELLA Tuck. f. *BEAUVOISII* (Del.) Vainio (p. 405). P—. Bristol (1934), Canaan (Muegel, 1936), Colchester (1934), Lisbon (1935), Mansfield (1934), New London (1936), Norwich (1935), Oxford (1936), Plainville (1935), Pomfret (Mrs. Paine, 1934), Salem (1935), Somers (1934), Stratford (1934), Warren (1934), Westbrook (1935), Winchester (1935), and Woodbury (1936).

CLADONIA CRISTATELLA f. *VESTITA* Tuck. (p. 407). Bristol (1934), Colchester (1934), Lisbon (1935), Naugatuck (1936), New London (1936), Norwich (1935), Plainville (1935), Pomfret (Mrs. Paine, 1934), Salem (1935), Somers (1934), Stratford (1934), Warren (1934), Winchester (1935), and Woodbury (1936).

CLADONIA CRISTATELLA f. *SQUAMOSISSIMA* Robbins (p. 408). Bethany (Muegel, 1935) and Voluntown (1935).

CLADONIA CRISTATELLA f. *PLEUROCARPA* Robbins (p. 408). Mansfield (1934), Oxford (1936), and Stratford (1934).

CLADONIA CRISTATELLA f. *SCYPHULIFERA* Sandst. (Notes II, p. 41), Colchester (1935) and Mansfield (1934).

CLADONIA CRISTATELLA f. *AURANTIACA* Robbins (Notes II, p. 41). Madison (*Muegel & Evans*, 1935) and New London (1936).

CLADONIA CRISTATELLA f. *OCHROCARPIA* Tuck. (p. 409). Woodbury (1936).

CLADONIA INCRASSATA Floerke (Notes, p. 129). P-. Canaan (1936), Mansfield (1934), Naugatuck (1936), and Southington (1936).

Section OCHROPHAEAE

Subsection UNCIALES

CLADONIA UNCIALIS (L.) Web. (p. 413). P-. Eastford (1934), Middletown (*Muegel*, 1935), Oxford (1936), Pomfret (*Mrs. Paine*, 1934), Somers (1934), Voluntown (1935), Warren (1934), and Westbrook (1935). The earlier record for Westbrook (p. 414) was based on specimens of *C. caroliniana* f. *dilatata* (Notes, p. 138).

CLADONIA UNCIALIS f. *SETIGERA* Anders (Notes, p. 134). Bethany (*Muegel & Evans*, 1935). Hartland (1934), Naugatuck (1936), Voluntown (1935), and Westbrook (1935).

CLADONIA UNCIALIS f. *SPINOSA* Oliv. (p. 417). Voluntown (1935).

CLADONIA UNCIALIS f. *SORALIGERA* Robbins (Notes II, p. 42). Groton (1936), Salisbury (1935), and Voluntown (1935).

CLADONIA CAROLINIANA (Schwein.) Tuck. f. *DILATATA* Evans (Notes, p. 138). P-. Cornwall (*Underwood*, 1890), Farmington (1934), Goshen (*Underwood*, 1890), Groton (1936), and Middletown (*Muegel*, 1935). The specimens from Cornwall have been listed as *C. uncialis* f. *obtusata* (p. 415) and those from Goshen as *C. uncialis* (p. 413). Both are in the Underwood Herbarium at the New York Botanical Garden.

CLADONIA CAROLINIANA f. *FIBRILLOSA* Evans (Notes, p. 139). Clinton (1935).

CLADONIA CAROLINIANA f. *TENUIRAMEA* Evans (Notes, p. 139). Bloomfield (1936), Naugatuck (1936), Salem (1935), and Westbrook (1935).

CLADONIA CAROLINIANA f. *PROLIFERA* Evans (Notes, p. 139). Glastonbury (1934) and Salisbury (1935).

CLADONIA BORYI Tuck. f. *LACUNOSA* (Bory) Tuck. (p. 418). P-. Canaan (*Muegel*, 1935), Groton (1936), Guilford (1935), Middletown (*Muegel & Evans*, 1935), North Canaan (*Muegel*, 1936), and Salisbury (1935).

Subsection CHASMARIAE

Group MICROPHYLLAE

CLADONIA FURCATA (Huds.) Schrad. (p. 420). P+. East Haddam (1934). This specimen is indefinite as to form.

CLADONIA FURCATA var. *RACEMOSA* (Hoffm.) Floerke (p. 422). Bloomfield (1936), Clinton (1935), Eastford (1934), Goshen (1935), Guilford (1935), Kent (1936), Somers (1934), Winchester (1935), and Woodbridge (1935).

CLADONIA FURCATA var. RACEMOSA f. FURCATOSUBULATA (Hoffm.) Vainio (p. 422). Clinton (1935), Litchfield (1936), Oxford (1936, det. Sandstede), and Salem (1935).

CLADONIA FURCATA var. RACEMOSA f. CORYMBOSA (Ach.) Vainio (p. 423). Guilford (1936).

CLADONIA FURCATA var. RACEMOSA f. FISSA (Floerke) Aigret (Notes, p. 153). Canaan (1936, det. Sandstede).

*CLADONIA FURCATA var. RACEMOSA f. RACEMOSELLA (Floerke) Sandst. in Rabenhorst, Kryptogamen-Flora 9, Abt. 4²: 204. 1931. *Cladonia furcata* *f. *fissa* subvar. *racemosella* Floerke, Clad. Comm. 152. 1828. On earth in a field. Goshen (1935, det. Sandstede).

Although this form is recognized by Sandstede it comes very close to f. *corymbosa*. It is characterized by the small and regular tufts which the podetia form and by the more or less fissured cortex in the vicinity of the apothecia.

CLADONIA FURCATA var. RACEMOSA f. SQUAMULIFERA Sandst. (Notes, p. 153). Bloomfield (1936), Branford (1936), Canaan (Muegel, 1936), Enfield (1934), Kent (1936), New Haven (Kleeberger, 1874, earliest record for town), Pomfret (Mrs. Paine, 1934), Portland (1934), Thomaston (McDonnell, 1935), Voluntown (1935), Warren (1935), Westbrook (1935), Woodbridge (Muegel & Evans, 1935), and Woodbury (1936).

CLADONIA FURCATA var. PALAMAEA (Ach.) Vainio (p. 425). Coventry (1934), Farmington (1934), Goshen (1934), Mansfield (1934), and Pomfret (Mrs. Paine, 1934).

CLADONIA FURCATA var. PINNATA (Floerke) Vainio (p. 424). Goshen (1935).

CLADONIA FURCATA var. PINNATA f. FOLIOLOSA (Del.) Vainio (p. 424). Warren (1935).

CLADONIA FURCATA var. PINNATA f. RECURVA (Hoffm.) Zahlbr. (Notes II, p. 44). Canaan (1936, det. Sandstede).

CLADONIA SCABRIUSCULA (Del.) Leight. f. FARINACEA (Vainio) Sandst. (p. 427). P+. Bethany (Muegel, 1935), Bristol (1934), Enfield (1934), Farmington (1934), Goshen (1934), Kent (1936), Oxford (1936), Pomfret (Mrs. Paine, 1934, det. Sandstede), Somers (1934), Woodbridge (Muegel, 1935), and Woodbury (1936).

CLADONIA MULTIFORMIS Merrill f. FINKII (Vainio) Evans (p. 429). P+. Canaan (1936), Goshen (1935), and Torrington (1934).

CLADONIA MULTIFORMIS f. SIMULATA Robbins (p. 429). Winchester (1935).

CLADONIA MULTIFORMIS f. SUBASCYPHA (Vainio) Evans (p. 430). Canaan (1936) and Goshen (1934).

CLADONIA SQUAMOSA (Scop.) Hoffm. (p. 432). P-. Norwich (Setchell, about 1886, not previously reported, Farlow Herbarium) and Warren (1935). These specimens are indefinite as to form.

CLADONIA SQUAMOSA f. DENTICOLLIS (Hoffm.) Floerke (p. 434). Thomaston (1935, det. Sandstede).

CLADONIA SQUAMOSA f. SQUAMOSISSIMA Floerke (p. 434). Canaan (*Muegel & Evans*, 1936) and Middletown (1935).

CLADONIA SQUAMOSA f. MURINA Scriba (p. 437). Branford (1936), Canaan (1936, det. Sandstede), and Woodbridge (1935, det. Sandstede).

CLADONIA SQUAMOSA f. CALLOSA (Del.) Anders (Notes II, p. 45). Bethany (1935, det. Sandstede) and Woodbridge (1935).

*CLADONIA SQUAMOSA f. FRONDOSA (Del.) Mass. Lich. Ital. Exsic. 292B. 1855; Sched. Crit. 159. 1855. *Cenomyce squamosa* $\delta.$ *frondosa* Del. in Duby, Bot. Gall. 625. 1830. On shaded rocks, Canaan (1936, det. Sandstede). For the characteristics of this form see Evans.¹

*CLADONIA SQUAMOSA f. MURICELLA (Del.) Vainio, Acta Soc. F. et Fl. Fenn. 4: 431. 1887 (as *C. squamosa* $\delta.$ *muricella*); Sandstede in Rabenhorst, Kryptogamen-Flora 9, Abt. 42: 271. 1931 (as form). *Cenomyce squamosa* *muricella* Del. in Duby, Bot. Gall. 626. 1830. *Cladonia squamosa* var. *muricella* Zahlbr. Cat. Lich. Univ. 4: 599. 1927. On rocks, Branford (1936, det. Sandstede).

The present form agrees with f. *phyllocoma* (p. 432) in having squamulose podetia but differs in being nearly or quite cupless. The tips of the branches, instead of forming cups, run out into long points or break up into clusters of branchlets, and the podetial surface in the upper part develops decorticate or granular areas.

CLADONIA SQUAMOSA f. CLAVARIELLA Vainio (Notes II, p. 46). Middletown (1935), Naugatuck (1936), Warren (1935), and Winchester (1935); all except the third determined by Sandstede.

CLADONIA SQUAMOSA f. PHYLLOPODA Vainio (Notes II, p. 46). Barkhamsted (1934) and Middletown (1935, det. Sandstede).

CLADONIA SQUAMOSA f. LEVICORTICATA Sandst. m. PSEUDOCRISPATA Sandst. (p. 436). Norwich (1935).

CLADONIA SQUAMOSA f. LEVICORTICATA m. RIGIDA (Del.) Evans (p. 436). North Branford (*Muegel & Evans*, 1935).

*CLADONIA SQUAMOSA f. CARNEOPALLIDA Sandst. Abhandl. Naturw. Ver. Bremen 25: 181. 1922. On dead moss and humus, Cedar Mountain, Hartford (*Clark*, 1933, det. Sandstede, not previously reported).

This form, which is apparently new to North America, is characterized mainly by its pale apothecia, varying in color from yellow to light reddish. The short podetia are more or less decorticate in the upper part and give off strongly fruiting branchlets.

CLADONIA DELICATA (Ehrh.) Floerke f. QUERCINA (Pers.) Vainio (p. 439). P+. Beacon Falls (*Muegel & Evans*, 1936), Branford (1936), Canaan (1936), Guilford (1936), Mansfield (1934), Naugatuck (1936), North Canaan (*Muegel*, 1936), and Thomaston (1935).

CLADONIA CAESPITICIA (Pers.) Floerke (p. 439). P+. Barkhamsted

¹ *Torreya* 35: 97. 1935.

(1934), Bloomfield (1936), Clinton (1935), Glastonbury (1934), Goshen (1935), Kent (1936), Litchfield (1936), Middletown (*Muegel*, 1935), Norwich (1935), Oxford (1936), Portland (1934), Salem (1935), Stratford (1934), Thomaston (*McDonnell*, 1935), Westbrook (1935), Winchester (1935), and Woodbridge (1935).

Group MEGAPHYLLOAE

CLADONIA APODOCARPA Robbins (p. 440). P+. Bristol (1934), Colchester (1935), Coventry (1934), Goshen (1935), Kent (1936), Naugatuck (1936, det. Sandstede), Voluntown (1935), Warren (1934), and Westbrook (1935).

CLADONIA TURGIDA (Ehrh.) Hoffm. (p. 441). P-. Canaan (1936).

Subsection CLAUSAE

Group PODOSTELIDES

CLADONIA MITRULA Tuck. f. IMBRICATULA (Nyl.) Vainio (p. 444). P+. Bristol (1934), Canaan (1936), Clinton (1935), East Haddam (1934), Guilford (1936), North Canaan (*Muegel & Evans*, 1936), Salem (1935), Stratford (1934), Winchester (1935), and Woodbury (1936).

CLADONIA MITRULA f. PALLIDA Robbins (p. 445). Clinton (1935).

*CLADONIA MITRULA f. **epiphylloma** f. nova, apothecia parva, conglomerata, sessilia in margine thalli primarii.

On a stump in an old pasture, North Canaan (1936).

Epiphyllous forms have been described under *C. clavulifera* (p. 448), *C. subcariosa* (p. 452), and several other species of Cladonia in which the apothecia are normally borne on distinct podetia. The present form is an analogue of these. The apothecia are about as large as in *f. microcarpa* Evans (p. 446) and occur in similar crowded clusters. The Connecticut specimens are associated with *f. imbricatula* and *C. pityrea* var. *Zwackhii* f. *subacuta*.

CLADONIA CLAVULIFERA Vainio f. NUDICAULIS Evans (p. 447). P+. Barkhamsted (1934), Beacon Falls (1936), Bloomfield (1936), Griswold (1933, listed in Notes II, p. 49, as *C. alpicola* f. *minor*; 1935, det. Sandstede), Kent (1936), Pomfret (1934), Sharon (1936), Simsbury (1936), and Woodbury (1936).

CLADONIA CLAVULIFERA f. SUBVESTITA Robbins (p. 447). Barkhamsted (1934), Beacon Falls (1936), Bloomfield (1936), Branford (1936, det. H. Sandstede as *C. clavulifera*), Kent (1936), and Woodbury (1936).

CLADONIA SUBCARIOSA Nyl. f. EVOLUTA Vainio (p. 450). P-. Barkhamsted (1934), Bloomfield (1936), Colchester (1935), Guilford (1936), Kent (1936), Mansfield (1934), Salem (1935), Southington (1935), Stratford (1934), Westbrook (1935), and Woodbridge (*Muegel*, 1935).

CLADONIA SUBCARIOSA f. *SQUAMULOSA* Robbins (p. 451). Madison (*Muegel*, 1935) and Salem (1935).

CLADONIA SUBCARIOSA f. *PLEUROCARPA* Robbins (p. 451). Colchester (1935).

Group THALLOSTELIDES

CLADONIA GRACILIS (L.) Willd. var. *DILATATA* (Hoffm.) Vainio (p. 457). P+. Canaan (*Muegel & Evans*, 1936), Goshen (1936), and Salisbury (*Darrow & Evans*, 1935).

CLADONIA GRACILIS var. *DILATATA* f. *SQUAMULOSA* (Schaer) Sandst. (p. 458). Canaan (*Muegel & Evans*, 1936).

CLADONIA VERTICILLATA (Hoffm.) Schaer. f. *EVOLUTA* (Th. Fr.) Stein (p. 459). P+. Enfield (1934), Hamden (*Mrs. Hobbs & Mrs. Black*, 1934), Kent (1936), Sharon (*Green*, 1884, Underwood Herbarium, not previously listed), Winchester (1935), and Woodbury (1936).

CLADONIA VERTICILLATA f. *APOTICTA* (Ach.) Vainio (p. 460). Enfield (1934) and North Branford (*Muegel*, 1935).

CLADONIA MATEOCYATHA Robbins f. *LEIOSCYPHA* Evans (p. 462). P+. Farmington (1934) and Pomfret (1934).

CLADONIA MATEOCYATHA f. *SQUAMULATA* Robbins (p. 462). Farmington (1934).

CLADONIA PYXIDATA (L.) Hoffm. var. *NEGLECTA* (Floerke) Mass. (p. 463). P+. Bethany (*Muegel*, 1935), Canaan (1936), Goshen (*Underwood*, 1890, Underwood Herbarium, not previously reported), Griswold (1935), and Kent (1936).

CLADONIA PYXIDATA var. *NEGLECTA* f. *SIMPLEX* (Ach.) Harm. (p. 464). Barkhamsted (1934), Bethany (*Muegel*, 1935), Bloomfield (1936), Clinton (1935), Colchester (1935), Coventry (1934), Goshen (1934, 1935), Kent (1936), Mansfield (1934, det. Sandstede), Oxford (1936), Pomfret (*Mrs. Paine*, 1934, det. Sandstede), Westbrook (1935), and Woodbury (1936).

CLADONIA CHLOROPHAEA (Floerke) Spreng. (p. 465). P+. In the present series of Notes the records for *C. chlorophaca* and *C. Grayi*, together with their numerous forms, are completely revised. The following lists, therefore, will supplant those in the writer's earlier papers. Bridgewater (1928), Brookfield (*Museh & Evans*, 1927), Cheshire (1932), East Haddam (*Clark*, 1932; *Evans*, 1934), East Haven (*R. Meyrowitz*, 1922), Goshen (*L. Sudbury*, 1927), Hamden (*Mrs. Black & Mrs. Hobbs*, 1933), Killingworth (1932), Ledyard (1927), Madison (1927, 1928), Meriden (1933), Milford (1932), North Branford (1928), Simsbury (1933), Southington (1936), Stamford (*Marshall*, 1928), Suffield (*Musch & Evans*, 1930), Wilton (1931), and Wolcott (1933). The specimens upon which these records are based are indefinite as to form.

CLADONIA CHLOROPHAEA f. *SIMPLEX* (Hoffm.) Arn. (p. 468). Avon (1933), Barkhamsted (1933), Beacon Falls (1936), Berlin (1927), Bethany (1925, 1935), Branford (1935), Bridgewater (1928), Canaan

(1928, 1936), Canton (1933), Cheshire (1932), Chester (*Musch & Evans*, 1928), Clinton (1927, 1935), Colchester (1932), Cornwall (1928), East Haddam (1933, 1934), East Hampton (1928), Enfield (1934), Essex (1931), Goshen (1927, 1935), Greenwich (1926), Guilford (1936), Hartland (1934), Lebanon (1932), Madison (1927, 1928, 1932), Meriden (*Musch*, 1927), Middlefield (1927), Milford (1931), Monroe (1933), Morris (*L. Sudbury*, 1927), New Fairfield (*McDonnell*, 1925), New Hartford (1928), near New Haven (*Kleeberger*, 1874), Newington (*Clark*, 1933), New London (1936), Norfolk (*Nichols*, 1912; *Evans*, 1928), North Branford (*Musch & Evans*, 1927; *Evans*, 1931), North Canaan (1928), North Haven (1931), Old Lyme (1930), Pomfret (*Mrs. Paine*, 1934). Portland (1933, 1934), Prospect (1928), Putnam (1925), Salisbury (1932, 1935), Seymour (*Musch & Evans*, 1928), Sherman (1928), Southbury (1928), Southington (*Clinton & Evans*, 1927; *Evans*, 1932), Stratford (1934), Suffield (*Musch & Evans*, 1930), Thomaston (1928), Westbrook (1927), Willington (1927, 1932), Wilton (1931), and Wolcott (1933).

CLADONIA CHLOROPHAEA f. *INTERMEDIA* Sandst. (Notes II, p. 52). Canton (1933) and Guilford (1928).

CLADONIA CHLOROPHAEA f. *COSTATA* (Floerke) Arn. (p. 469). Goshen (*Underwood*, 1890, *Underwood Herbarium*), Morris (*L. Sudbury*, 1927), and Pomfret (*Mrs. Paine*, 1934).

CLADONIA CHLOROPHAEA f. *PROLIFERA* (Floerke) Vainio (p. 469). Berlin (1927).

CLADONIA CHLOROPHAEA f. *PTERYGOTA* (Floerke) Vainio (p. 470). Branford (1932), Canaan (1936), Cornwall (1928), North Branford (1931), and Saybrook (*Musch & Evans*, 1928).

CLADONIA CHLOROPHAEA f. *CARPOPHORA* (Floerke) Anders (p. 470). Berlin (1927), Branford (1928), Goshen (1935), Kent (1936), Killingworth (1932, 1933), Litchfield (1933), Simsbury (1933), Winchester (1931), and Woodbury (1936).

CLADONIA CHLOROPHAEA f. *HOMODACTYLA* (Wallr.) Robbins (p. 471). Madison (1927).

CLADONIA CHLOROPHAEA f. *LEPIDOPHORA* (Floerke) Sandst. (p. 471). East Hampton (1928), Goshen (1935), Litchfield (1936), North Branford (*Musch & Evans*, 1927), North Canaan (1928), Saybrook (*Musch & Evans*, 1928), and Southington (1927).

**CLADONIA CHLOROPHAEA* f. *PACHYPHYLLINA* (Wallr.) Sandst. in Rabenhorst, *Kryptogamen-Flora* 9, Abt. 4²: 421. 1931. Durham (1932), New Milford (1923), and North Branford (*Musch & Evans*, 1927).

In the writer's report, p. 472, this form is treated as a variety of *C. chlorophaea*, following the example of Vainio. Sandstede, however, gives it the subordinate rank of form.

**CLADONIA CHLOROPHAEA* f. *PERITHETA* (Wallr.) Arn. Lich. Exsic. (Icon. Clad.) No. 1496. dextr. 1890 (as modification); Kovář, *Věstník*

Klubu přirod. Prostějove 15: 166. 1912 (as form). *Patellaria fuscæ* f. *pyxioïdes* e. m. *perithetum* Wallr. Naturg. Säulch.-Flect. 154. 1829. In a bog. Bethany (1935, det. Sandstede).

The podetia in this form give off cup-like proliferations from the outer surface.

**CLADONIA CHLOROPHAEA* f. *CONISTEA* Del. in Harmand, Lich. France 3: 304. 1907. On earth, sometimes over rocks, and on stumps. Barkhamsted (1934), Bristol (1934), Farmington (1934), Glastonbury (1927), Goshen (1935), Kent (1936), Litchfield (1933), near New Haven (Livingston, 1872), North Branford (*D. Arnold*, 1933), North Canaan (1936), Sharon (1936), Westbrook (1935), Wethersfield (*Clark*, 1933), Winchester (1935), and Woodbury (1936). Most of these records are based on Sandstede's determinations.

The writer (Notes II, p. 53) has already called attention to this interesting form and to the strong resemblance that it bears to *C. conista*. In their general morphology the podetia of these two plants, which expand gradually into goblet-like cups, are much alike. In *f. conistea*, however, the soredia are granular and the podetial cortex below the sorediose portion is more or less verruculose. In *C. conista*, on the other hand, the soredia are farinose and the podetial cortex, which consists of smooth areolæ in close contact, is never verruculose.

CLADONIA GRAYI Merrill (Notes, p. 159). P—. Beacon Falls (1928), Berlin (1927), Bethany (1927), Branford (1928), Burlington (1933), Canton (1933), Clinton (1927), Darien (1926), Durham (1928), East Hampton (1928), Essex (1927), Goshen (1935), Guilford (*M. Fulford*, 1932; *Evans*, 1932, 1936), Hamden (*Mrs. Hobbs*, 1932), Hartford (*Clark*, 1933), Lisbon (1935), Litchfield (1933), Middletown (1932), North Haven (1927), Plainville (*Wright*, 1883), Stratford (1933), Torrington (1934), Union (1927), Westbrook (1927), and Wilton (1931).

The morphological distinctions between *C. chlorophaea* and *C. Grayi* are still indefinite, but an important chemical difference makes it easy to separate the species. *C. chlorophaea*, in other words, is characterized by the presence of the bitter fumarprotocetraric acid, whereas *C. Grayi* lacks this substance completely and is mild to the taste. The application of paraphenylenediamine makes this difference apparent to the sight. With *C. chlorophaea* the characteristic reddish or reddish orange color promptly appears but with *C. Grayi* the reaction is negative or nearly so. The specimens here listed under *C. Grayi* and its various forms are all negative to this reagent.

Both *C. chlorophaea* and *G. Grayi* are abundant in eastern North America and both are exceedingly variable. Under *C. chlorophaea*

numerous forms are at present recognized, although some of these are connected by intergradations. Under *C. Grayi* very similar forms can be distinguished but only two of these, f. *cyathiformis* Sandst. and f. *squamulosa* Sandst., have as yet been published. In the present paper three additional forms, all of which are analogous to forms of *C. chlorophaea*, are proposed. The specimens upon which the above records are based, as in the case of the similar records under *C. chlorophaea*, are indefinite as to form.

***CLADONIA GRAYI** f. **simplex** Robbins, f. *nova*, podetia simplicia, esquamulosa, sterilia, margine integro aut subintegro.

On earth, logs, and tree-bases. Barkhamsted (1928), Beacon Falls (1928, 1936), Bethany (1935), Branford (1928, 1932), Bristol (1933), Burlington (1933), Canterbury (1933), Canton (1933), Cornwall (1926), Durham (1928), East Hampton (1932), Enfield (1934), Essex (1931), Fairfield (1931), Glastonbury (*L. Sudbury*, 1927; *Evans*, 1934), Griswold (1933), Guilford (*Nichols*, 1921; *Evans*, 1925, 1928, 1932, 1935), Hamden (*Mrs. Black*, 1933), Hartland (1928), Harwinton (1933), Kent (1936), Killingworth (*Hall*, 1874; *Evans*, 1931, 1932), Litchfield (1927), Lyme (1931), Mansfield (1934), Meriden (*Musch & Nichols*, 1926), Middlefield (1932), New London (1936), North Branford (*Musch & Evans*, 1927; *Evans*, 1928, 1935), North Canaan (1928), North Haven (*Evans*, 1927, 1931; *Darrow*, 1935), Old Lyme (1927, 1930), Old Saybrook (1931), Pomfret (*Mrs. Paine*, 1934; *Evans*, 1934), Salem (1935), Shelton (1928), Somers (1934), Suffield (*Smith*, 1933), Thomaston (1933), Torrington (*Clinton*, 1928), Voluntown (1935), Westbrook (1927), and Windsor (1928).

As in the case of the analogous *C. chlorophaea* f. *simplex*, the present form may represent either a stage in the development of one of the more complex forms or a definitely arrested condition which will not develop further. The podetia, which remain sterile, are characterized by their lack of squamules and of proliferations, and the margins of the cups are either entire or vaguely and irregularly denticulate. Uniform colonies of f. *simplex* are not infrequent, but the form may occur also in association with one or more of the following forms.

CLADONIA GRAYI f. **CYATHIFORMIS** Sandst. (Notes II, p. 53). Coventry (1934) and Meriden (1927).

***CLADONIA GRAYI** f. **prolifera** Sandst. f. *nova*, podetia prolifera, esquamulosa, sterilia, proliferationibus haud numerosis scyphiferis.

On earth. Guilford (*Nichols*, 1921) and Old Saybrook (1931).

In f. *prolifera*, which is the analogue of *C. chlorophaea* f. *prolifera*, the podetia agree with those of f. *simplex* in being sterile and in lacking squamules but differ in being proliferous. The proliferations arise

singly or in small numbers from the margins of the primary cups and are themselves cup-forming.

**CLADONIA GRAYI* f. *carpophora* f. *nova*, podetia squamis destituta, fertilia, apothecia e margine scyphorum enata, parce aggregata, sessilia aut stipitata.

On earth and old wood. Branford (1928, 1936), Canaan (Muegel, 1935), Canterbury (1933), Eastford (1934), East Haddam (1927), Enfield (1934), Glastonbury (1934), Goshen (1935), Granby (Musch & Evans, 1930), Greenwich (1931), Griswold (Evans, 1933; Snow, 1935), Guilford (1936), Hamden (Mrs. Black, 1933), Hartland (1928, 1933), Killingworth (1933), Lyme (1931), Madison (1927), North Branford (1931, 1935), North Haven (Olmsted, 1935), Old Lyme (1927), Old Saybrook (1931), Portland (1933), Saybrook (Musch & Evans, 1928), Shelton (1928), Simsbury (1933, 1936), Stamford (1928), Torrington (1934), Winchester (1931), Windsor (1927), Wolcott (1933), and Woodbury (1936).

This fertile form of *C. Grayi*, in which the podetia are free from squamules, is comparable with *C. chlorophaca* f. *carpophora* but is of more frequent occurrence in Connecticut. Although the form has much in common with f. *simplex*, the large brown apothecia, which are usually produced in abundance, give the plants a strikingly different appearance. These apothecia are either sessile on the margins of the cups or borne on marginal stipes which vary greatly in length. The podetia in most cases are dark grayish green or olive-green and thus differ in color from the podetia of f. *simplex*, which tend to be pale grayish green or whitish gray.

CLADONIA GRAYI f. *SQUAMULOSA* Sandst. (Notes, p. 160). Branford (1928), Burlington (1933), Chester (Musch & Evans, 1928), Colchester (1932), Glastonbury (1934), Goshen, (L. Sudbury, 1927), Guilford (1932), Hamden (Mrs. Hobbs, 1932; Mrs. Black, 1933), Lebanon (1932), Madison (1927), Morris (1927), New Canaan (1926), New Haven (Clinton, 1927), New London (1936), North Branford (1935), Old Lyme (1927, 1930), Old Saybrook (1931), Shelton (1928), Simsbury (1936), Somers (1934), Stamford (1928), Thomaston (1927), Voluntown (1933), Wallingford (1931), Westbrook (1927), and Woodbridge (1935).

Under *C. chlorophaca* the sterile squamulose form is distinguished as f. *pterygota*, and two fertile squamulose forms, f. *lepidophora* and f. *pseudotrichyna*, are recognized. Under *C. Grayi*, however, f. *squamulosa* is understood in a more comprehensive sense and includes both sterile and fertile plants. Unfortunately the specimens from Burlington, which have been recorded under *C. chlorophaca* f. *pseudotrichyna* (Notes II, p. 51), give a negative reaction with paraphenylenediamine.

It has therefore been necessary to transfer them to *C. Grayi* f. *squamulosa*, as indicated above.

CLADONIA CONISTA (Ach.) Robbins f. *SIMPLEX* Robbins (p. 473). P+. Goshen (1935), Mansfield (1934), and Winchester (1935).

CLADONIA FIMBRIATA (L.) Fr. (p. 473). P+. Prospect (1928) and Salisbury (1928). These two specimens are listed under f. *stenoscypha* in the writer's report (p. 475). They evidently represent, however, the more typical condition of the species, since the podetia are all cup-forming.

CLADONIA CORNUTORADIATA* (Coem.) Sandst. Abhandl. Naturw. Ver. Bremen **21: 373. 1912. *C. fimbriata* f. *cornuto-radiata* Coem. Bull. Acad. Roy. Belgique II. **19**: 40. 1865. *Cenomyce cornuto-radiata* Zopf, Flechtenstoffe 407. 1907. P+.

The choice of a name for this species is beset with many difficulties. The name *cornutoradiata* (originally written with a hyphen) was proposed by Coemans as the name of a form in 1865 and was first used in a specific sense by Zopf in 1907. Under *C. cornutoradiata*, as at present defined, two forms are included which are based on much earlier species. One of these is f. *radiata* (Schreb.) Sandst., based on *Lichen radiatus* Schreb., which dates from 1771; and the other f. *subulata* (L.) Sandst., based on *Lichen subulatus* L., which dates from 1753. According to the current rules of nomenclature the aggregate species including these two old species should retain the name of the older of the two, i.e., of the Linnaean species. This, however, would lead to further uncertainties since *Lichen subulatus* L., according to Vainio,¹ was based on at least two unrelated species. Under the circumstances it is perhaps advisable to use the name *C. cornutoradiata*, at least provisionally.

The species is exceedingly variable, and several of its more distinct forms have been well figured.² It agrees with most of the other members of the *C. fimbriata*-group in producing an abundance of farinose soredia and in having the sorediose areas occupy the greater part of the podetial surface. The podetia tend to be longer and more slender than in the related species and may either taper to long points or be tipped with narrow cups, which usually bear marginal proliferations. In the majority of the forms the podetia are entirely free from squamules. The distribution of *C. cornutoradiata* is still imperfectly known, but its range in North America is apparently distinctly

¹ Acta Soc. F. et Fl. Fennica **10**: 287. 1894.

² See Zopf, Ber. Deutsch. Bot. Gesell. **26**: pl. 1. 1907; Anders, Strauch- und Laubfl. Mitteleuropas pl. 17, f. 1-3. 1928; and Sandstede in Rabenhorst, Kryptogamen-Flora **9**, Abt. 4²: pl. 31, f. 1-7. 1931.

northern. The plants rarely occur in extensive colonies but usually singly or in small patches in association with other *Cladoniae*. The following form has recently been discovered in northern Connecticut:

**CLADONIA CORNUTORADIATA* f. *RADIATA* (Schreb.) Sandst. *Abhandl. Naturw. Ver. Bremen* 21: 373. 1912. *Lichen radiatus* Schreb. *Spic. Fl. Lips.* 122. 1771. *Cladonia radiata* Willd. *Fl. Berol. Prodr.* 363. 1787. On earth, Goshen (Clinton, 1936, determination confirmed by Sandstede).

Among the cup-bearing forms of *C. cornutoradiata*, f. *radiata* is one of the most distinctive. It is characterized by the form of the cups, which broaden out very gradually from long stalks, and by the marginal proliferations. These are short and horn-like and extend vertically upward or nearly so. In the Connecticut material the podetial stalks are 2-3 cm. in height by 1-2 mm. in diameter, and the cups measure 4-5 mm. across. The proliferations are mostly four to eight in number and vary considerably in length.

CLADONIA NEMOXYNA (Ach.) Nyl. (p. 475). P+. Bloomfield (1936), Bristol (1934), Canaan (1936), Colchester (1935), Goshen (1935), Kent (1936), Oxford (1936), Sharon (1936), Stratford (1934), Torrington (1934), and Woodbury (1936).

The name *nemoxyna* was proposed in a subspecific sense by Acharius in 1803 but was not used in a specific sense until 1892 (see the writer's Report, p. 475). The species includes, however, two forms the names of which were used in a specific sense at much earlier dates. The first of these is f. *fibula* (Ach.) Vainio, based on *Lichen fibula* Ach., which dates from 1798; and the second is f. *Rei* (Schaer.) Anders, based on *Cladonia Rei* Schaer., which dates from 1823 (see below). The specific name *fibula* is apparently not available for the present species, since there is an older *Cladonia fibula* of Hoffmann, dating from 1796 and distinct from *Lichen fibula* Ach.; but there seem to be no valid objections to the specific name *Rei*, although Schaerer himself reduced his species to subordinate rank in 1850, under the name *C. cornuta* f. *Rei*.¹ The continued use of the name *nemoxyna*, therefore, must be regarded as more or less provisional, comparable with the use of the specific name *cornutoradiata*.

Both Anders and Sandstede state that *C. nemoxyna* is mild to the taste. The application of paraphenylenediamine, however, shows that a negative reaction is by no means constant but that the majority of the specimens which have been referred to *C. nemoxyna* give a

¹ *Enum. Crit. Lich. Europ.* 196. 1850.

distinctly positive reaction.¹ Sandstede, according to a recent letter, now distinguishes plants which are P+ and bitter, plants which are P+ and mild, and plants which are P- and mild. In his opinion the plants which are P+ contain the bitter fumarprotocetraric acid, although the amount in the mild specimens is too small to be detected by the taste. Such plants he retains under *C. nemoxyna* but thinks that the P- and mild plants should be separated from *C. nemoxyna* as a distinct species. This species, to which he has given a provisional name, contains no fumarprotocetraric acid. It would therefore be comparable with *C. Grayi*, which is distinguished from *C. chlorophphaea* by the same chemical difference. The following records are based on P- plants, which represent Sandstede's provisional species: Cornwall (1928), Gilford (1928), Ledyard (1927), Madison (1927), and Westbrook (1927). These stations are all listed under *C. nemoxyna* in the writer's Report (p. 476).

CLADONIA NEMOXYNA f. FIBULA (Ach.) Vainio (p. 477). Branford (1936), Canaan (1936), Colechester (1935), Goshen (1934), Guilford (1935), North Canaan (Muegel & Evans, 1936), Torrington (1934), and Woodbury (1936).

***CLADONIA NEMOXYNA f. REI** (Schaer.) Anders, Strauch.- und Laubfl. Mitteleuropas 114. 1928. *Cladonia Rei* Schaer. Lich. Helv. Spic. 34. 1823. On earth at base of boulder, Goshen (1935, det. Sandstede).

In this interesting form isidia are present among the coarse granular soredia, and the podetia are more or less squamulose, especially toward the base.

CLADONIA CONIOCRAEA (Floerke) Spreng. f. **CERATODES** (Floerke) Dalla Torre & Sarnth. (p. 479). P+. Canaan (1936), Clinton (1935), Colchester (1934), Goshen (1935), Kent (1936), Norwich (1935), Pomfret (Mrs. Paine, 1934), Salem (1935), Southington (1936), and Winchester (1935).

CLADONIA CONIOCRAEA f. TRUNCATA (Floerke) Dalla Torre & Sarnth. (p. 480). Canaan (1936), Guilford (1935), Kent (1936), Norwich (1935), Southington (1936), Warren (1935), and Winchester (1935).

CLADONIA CONIOCRAEA f. PHYLLOSTROTA (Floerke) Vainio (p. 481). Middletown (1935).

CLADONIA CONIOCRAEA f. EXPANSA (Floerke) Sandst. (Notes, p. 160). Canaan (Muegel & Evans, 1936, det. Sandstede), Oxford (1936), and Warren (1935, det. Sandstede).

CLADONIA CONIOCRAEA f. PYCNOTHELIZA (Nyl.) Vainio (Notes, p.

¹ See also Asahina, Acta Phytochimica 8: 53. 1934.

161). Canaan (1936), Goshen (1935), Middletown (1935). Thomaston (1935), and Warren (1935).

**CLADONIA CONIOCRAEA* f. *stenoscypha* (Stuckenberg) Sandst. comb. nov. *C. fimbriata* var. *apolepta* f. *stenoscypha* Stuckenberg, Rech. Clad. Gouv. Penza et Saratow 60. pl. 3, f. 8. 1917. *C. fimbriata* f. *stenoscypha* Evans, Trans. Connecticut Acad. 30:475. 1930. Canaan (1936), Goshen (1935), Hartland (1928), North Canaan (1928), North Branford (1931, not previously reported), and Winchester (1935).

At the suggestion of Dr. Sandstede (see Notes II, p. 54) the writer here transfers his *C. fimbriata* f. *stenoscypha* to *C. coniocraea* and reduces it to synonymy under the new combination *C. coniocraea* f. *stenoscypha* (Stuckenberg) Sandst. Through a curious coincidence both Mrs. Stuckenberg and the writer had proposed the form-name *stenoscypha* independently for the same plant.

CLADONIA OCHROCHLORA Floerke (Notes II, p. 55). P+. Thomaston (1935).

CLADONIA BORBONICA (Del.) Nyl. f. *CYLINDRICA* Evans (p. 482). ~~Pt.~~ Bristol (1934, det. Sandstede), Clinton (1935), Coventry (1934), Farmington (1934), Goshen (1934), Kent (1936), Mansfield (1934), Oxford (1936), Pomfret (Mrs. Paine, 1934), Sharon (1936), Thomaston (1935), Warren (1935), and Woodbury (1936).

CLADONIA BORBONICA f. *SQUAMULOSA* Robbins (p. 482). Mansfield (1934).

CLADONIA PITYREA (Floerke) Fr. (p. 483). P+. Mansfield (1934), not referable to any definite form.

CLADONIA PITYREA var. *ZWACKHII* Vainio f. *SUBACUTA* Vainio (p. 485). Goshen (1935), Guilford (1936), Kent (1936), Litchfield (1936), Naugatuck (1936), Norwich (1935), and Woodbury (1936).

CLADONIA PITYREA var. *ZWACKHII* f. *SQUAMULIFERA* Vainio (p. 485). Clinton (1935), Goshen (1935), Guilford (1936), Litchfield (1936), and Thomaston (1935).

Group FOLIOSAE

CLADONIA STREPSILIS (Ach.) Vainio (p. 487). P-. Bloomfield (1936, det. Sandstede), and Canaan (Mucigel, 1936), sterile material.

CLADONIA STREPSILIS f. *GLABRATA* Vainio (p. 488). Salem (1935), Southington (1935), and Warren (1934).

CLADONIA STREPSILIS f. *CORALLOIDEA* (Ach.) Vainio (p. 489). Branford (1936), Bristol (1934), Mansfield (1934), and Plainville (1935).

CLADONIA STREPSILIS f. *SUBSESSILIS* Vainio (p. 489). Sharon (1936).

CLADONIA STREPSILIS f. *COMPACTA* Anders (Notes, p. 163). Woodbury (1936).

Group OCHROLEUCAE

CLADONIA PIEDMONTENSIS Merrill f. *OBCONICA* Robbins (p. 491).
P—. Salem (1935).

**CLADONIA PIEDMONTENSIS* f. *INTERMEDIA* Robbins, *Rhodora* 31: 104. *pl. 187, f. 8-10.* 1929. On earth in a field, Salem (1935).

In this form both large and small apothecia are present, and the podetia are either smooth throughout or squamulose toward the base.

**CLADONIA PIEDMONTENSIS* f. *PHYLLOCOMA* Robbins, *Rhodora* 31: 104. *pl. 187, f. 11, 12.* 1929. On earth in a field, Salem (1935).

This form agrees with the preceding in having both large and small apothecia but differs in being more or less squamulose throughout.

CLADONIA PIEDMONTENSIS f. *LEPIDIFERA* (Vainio) Robbins (p. 491). Salem (1935) and Somers (1934).

CLADONIA PIEDMONTENSIS f. *EPIPHYLLA* Robbins (Notes II, p. 57). New London (1936).

At the close of 1933 (see Notes II, p. 57) collections of Cladonae had been made in 119 of the Connecticut towns. The explorations of the past three years have increased this number to 132, so that only 37 towns are still to be heard from. Even in the most thoroughly explored towns, however, further search ought to bring additional species and forms to light.

At the present time 46 towns can be listed in each of which 16 or more species of Cladonia have been collected. This represents an addition of 7 towns since 1933. The town still standing at the head of the list is Madison, with 37 species to its credit. Close rivals are North Branford with 35 species, Killingworth with 34, Old Saybrook with 31, and North Canaan and Goshen with 30 each. The other towns with 25 or more species each are the following: Bethany, East Hampton, Guilford, and North Haven, 29 species; Litchfield, 28; Branford, Canton, and Salisbury, 27; Barkhamsted, Beacon Falls, East Haddam, and Wallingford, 25.

The local distribution of the more common species of Cladonia was summarized in the writer's original report (p. 498). At that time *C. cristatella* stood at the head of the list with 62 towns to its credit, and *C. chlorophaca* (including *C. Grayi*) stood second with 60 towns. *C. cristatella* still stands at the head of the list but is now known from 102 towns. The species next in order are the following: *C. tenuis*, known from 87 towns; *C. bacillaris*, from 86; *C. pleurota*, from 84; *C. furcata*, from 74; *C. chlorophaca* and *C. Grayi*, from 73 each; *C. coniocraea*, from 69; *C. subcariosa*, from 61; and *C. mitrula*, from 59. Of the remaining species 22 are known from 20 or more towns each and 10 from

only 1 to 3 towns. These rarities of the Connecticut flora are *C. alpestris* (L.) Rabenh. (p. 387), *C. digitata*, *C. carassensis* Vainio (Notes II, p. 47), *C. crenata* (Ach.) Schaer. (Notes, p. 154), *C. glauca* Floerke (p. 437), *C. alpicola* (Flot.) Vainio (Notes II, p. 48), *C. Norrlini* Vainio (p. 454), *C. decorticata* (Floerke) Spreng. (Notes, p. 158), *C. cornutoradiata*, and *C. ochrochlora*.

OSBORN BOTANICAL LABORATORY, YALE UNIVERSITY

ON *POGOTRICHUM FILIFORME*.—This species was first collected at Helgoland by Major T. Reinbold in June, 1888 on *Laminaria*. It was described by Reinke in 1892, and figured by Dr. Kuckuck in Reinke's *Atlas* (Pl. 41).

The winter of 1892-'93 was of unusual severity in New England. For miles, Vineyard Sound was closely packed with jagged pieces of ice. By a search lasting much of two or three days, I found among them three depauperate specimens of a pale brown alga, about 6-8 mm. high. They were well fruited, and were identified by Dr. Farlow as *Pogotrichum filiforme*. This was subsequently reported by myself.¹

Since that time I have found numerous specimens, always on *Zostera*, along southern New England as far west as Connecticut. After a severe storm in September, 1911, I collected a single specimen which was washed ashore along Penobscot Bay. Dr. Collins also reports it from Casco Bay, Maine.² It also occurs among the Faroes, and along Iceland. We thus have a rather complete chain of stations from the north Atlantic, where it seems to have been evolved.

I can not resist hazarding the guess that it is a recent migrant along our shores. The original specimens of Reinbold are dark in color, and about 50 mm. high. At first, ours were very small and pale. As time went on, they not only grew in abundance, but increased in size and became darker in color. Kuckuck found a few thalli which he thought might be sporangial; ours uniformly bore gametangia. Most of the specimens from Europe are polysiphonous; ours, without exception, are monosiphonous. I should, in this connection, note what may be an exception to this latter statement. It has frequently been suspected that this species is the *Litosiphon pusillus* of Harvey. (This is the proper form, and not *Lithosiphon* as it is commonly written.) About 1899 I collected in Narragansett Bay a scantily

¹ See *RHODORA* vol. 2, pp. 206 and 207. 1900.

² Collins, *Proc. Portland Soc. Nat. History*, Vol. 2, p. 270.

fruited, polysiphonous specimen which Dr. Collins, with much hesitation, called *Litosiphon*. Plainly, it was different from our *Pogotrichum*. I call attention to this problem, in the hope that some future worker may clear up this perplexing situation.—R. E. SCHUH, Brooklin, Maine.

A NOTE ON PHYCOLOGICAL NOMENCLATURE.—I called attention in a recent note¹ to the para-homonymy which had existed between the generic names *Coriophyllum* Rydb. and *Coriophyllum* Setch. & Gardn. until Setchell & Gardner in Univ. Calif. Publ. Bot. 16: 341 (1927) proposed for the latter the new name *Asymmetria*. A similar case of purely orthographic variation exists between *Herpophyllum* J. Ag. and *Herpophyllum* Farlow. Here an additional source of confusion lies in the taxonomic proximity of the two genera of red algae so designated. Under Article 70, Notes 3 and 4, of the International Rules of 1935, the name *Herpophyllum* Farlow is illegitimate and must be rejected.² In its place I propose a new name, after Dr. Francis Drouet, American student of algae:

DROUETIA J. DeToni, nom. nov. *Herpophyllum* Farlow, Thallog. Galapagos Ids., p. 97 (1902); J. B. DeToni, Syllog. Alg. 4(4): 1713 (1905), idem 6: 598 (1924). Non *Herpophyllum* J. Ag., Anal. Algol. Cont. 2: 62 (1894).

DROUETIA coalescens (Farlow) J. DeToni, comb. nov. *Herpophyllum coalescens* Farlow, loc. cit. (1902); J. B. DeToni, loc. cit. (1905, 1924).—GIUSEPPE DETONI, Brescia, Italy.

ECHINODORUS TENELLUS, A CORRECTION.—In reporting the occurrence of a number of plants in York County Maine,³ *Echinodorus tenellus* (Mart.) Buchenau was included in the notes. This was based upon dried specimens from a silt-depositing estuary at South Berwick, Maine, collected in 1935, and sent to an herbarium. Since that time, an intensive search has failed to disclose a specimen of that species. A critical reexamination of recorded material shows that *Echinodorus tenellus* should be withdrawn from the flora of Maine.—ANNE E. PERKINS, Berwick, Maine.

¹ DeToni, G. 1935. Noterelle di nomenclatura algologica. II. Il genere *Coriophyllum* Setchell & Gardner 1917 (Floridee). Tip. Morcelliana, Brescia.

² My late father, Prof. J. B. DeToni, wrote concerning this name in Syllog. Alg. 6: 598 (1924): "Nomen propter similitudinem cum alio genere, q. e. *Herpophyllum* J. Ag., forsitan esset mutandum."

³ 1936. RHODORA 38: 452-453.

NAJAS GRACILLIMA IN MISSOURI.—Dr. Fernald's discussion¹ in 1923 of the distribution of *Najas gracillima* (A. Br.) Morong revealed that the species was limited to Maine, Connecticut, Massachusetts, New York, Pennsylvania and New Jersey, and that the "customary" reports of it for Missouri were all false. But in 1936, R. T. Clausen² cited records to show that the range of this species had been extended by recent collectors to include Minnesota and Wisconsin; and in 1937 he reported it from Indiana and Michigan.³

The writer, therefore, received something of a distributional shock while collecting in Missouri during the summer of 1937. In a shallow upland pond 3½ miles south of Licking, Texas Co. in the heart of the Ozarks he collected an unfamiliar looking species of *Najas*. The pond was full of *Sagittaria rigida* Pursh and *Potamogeton diversifolius* Raf., while growing around the pond margin were *Glyceria acutiflora* Torr., *Cyperus acuminatus* Torr. & Hook. and *Scirpus validus* Vahl, not even an unusual assemblage of species. The pond, however, has now made a name for itself, because careful examination of the *Najas* material subsequently has proven it to be the rare *N. gracillima* (A. Br.) Morong, the first authentic record for Missouri. Missouri in fact becomes its southwestern limit of range known. The writer's collection of it is from an upland pond, 3½ miles south of Licking, Texas Co., Missouri, July 15, 1937, Steyermark 23277, and specimens may be found in Gray Herbarium, New York Botanical Garden Herbarium, Missouri Botanical Garden Herbarium, and Herbarium of the Field Museum.—JULIAN A. STEYERMARK, Field Museum of Natural History, Chicago, Illinois.

¹ Fernald, M. L. Distribution of *Najas* in northeastern America. *RHODORA* 25: 109. 1923.

² Clausen, R. T. The Genus *Najas* in the United States. *RHODORA* 38: 338-341. 1936.

³ Clausen. *Najas gracillima* in Indiana and Michigan. *RHODORA* 39: 432. 1937.

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